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CITATION:

Tran Thanh Duc ...[et al]. Living with typhoon and flood disasters : a case study in Huong Phong commune, Tam Giang lagoon area, central Vietnam. SANSAI : An Environmental Journal for the Global Community 2012, 6: 85-96

ISSUE DATE:

2012-12-10

URL:

http://hdl.handle.net/2433/170264

Living with typhoon and flood disasters: a case study in Huong Phong commune, Tam Giang lagoon area, central Vietnam

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Abstract
Central Vietnam frequently suffers from typhoons and floods. Disaster preparedness for local residents is one of the major focuses of efforts to mitigate natural disasters. In Huong Phong commune, located beside the Tam Giang lagoon in Huong Tra district, Thua Thien Hue province, a research team focused on three specific objectives: 1) evaluating the impacts of typhoons and flooding on local residents over the past 25 years, 2) describing the activities of local authorities in responding to natural disasters, and 3) identifying disaster adaptation and mitigation behavior of local residents. The study shows that local residents' working and living conditions were seriously influenced by typhoons and flooding, particularly by major flooding in 1999. To reduce the impact of disasters, Committees for Flood and Typhoon Control were established at the commune and village levels to coordinate the preparedness and response of residents before, during and after floods and typhoons. Preparedness and response efforts at the local level are mainly based on local resources, under the guiding credo "four on the spot," which covers local leadership, local forces on the spot, local materials and local logistics when organizing disaster prevention activities. The study found that, to prepare themselves for future disasters, local people diversified their work, constructed reinforced houses with elevated foundations and mezzanine levels, stocked up on food reserves, bought boats and used their local knowledge to help predict future floods and typhoons.

Keywords
Typhoons, flooding, local adaptation, house construction, central Vietnam.

Introduction

Central Vietnam is a long and narrow region that frequently suffers from typhoons and floods. According to 2009 figures, about 75.8 per cent of the population lives in rural areas (General Statistical Office, Vietnam 2010), with most people dependent on agriculture for their livelihoods. Central Vietnam has not shared in the impressive recent growth of the rest of the Vietnamese economy. The region is well known as one of the country's three poorest regions, with an average poverty rate of 17.6 per cent compared with a nationwide average rate of 12.3 per cent (ibid.). Thua Thien Hue, one of the 14 provinces of central Vietnam, is

in a transitional climatic zone between northern and southern Vietnam that has a tropical monsoon climate. The dry season extends from April to July and the rainy season from September to December. The annual average rainfall for 2005-2009 was 3,520 mm and the annual average temperature was 24.6°C. The highest temperature of 29.3°C was recorded in June and the lowest temperature of 19.4°C recorded in January (Thua Thien Hue Statistical Office 2010). Thua Thien Hue is one of the Vietnamese provinces most prone to natural disasters, particularly flooding. Floods in Thua Thien Hue have two principal causes: rapid currents flowing down stream from the mountains in the Huong and Bo river watersheds after heavy rainfall, and flood tides carried inland from the ocean by strong winds. Flooding mainly affects the lowlands, particularly lagoon areas (Le and Ho 2007).

There are four flooding alarm levels used in Vietnam (Tran et al. 2010): alarm level I (possible flood conditions), alarm level II (dangerous flood conditions), alarm level III (very dangerous flood conditions) and alarm level III^{+} (emergency flood conditions). In line with Decision 632/QD-TTg of the Vietnamese Prime Minister's office in 2010, water levels corresponding to alarm levels I, II, III and III^{+} at the Hue measuring station on the Huong river of Thua Thien Hue province are 1 m, 2 m, 3.5 m and above 3.5 m, respectively. The frequency of floods (associated with alarm levels of II upwards) and typhoons in the province was calculated as 3.44 events per year, averaged from 1978 to 2004, and 0.84 events per year, from 1884 to 2000 (Social Sciences Publishing House 2005). In the past few decades, the frequency and severity of disasters in Thua Thien Hue province have shown an increasing trend. According to Do (2002) there were only 38 floods and typhoons recorded in the 141-year span from 1804 to 1945. In contrast, between 1975 and 2000, there were 41 disasters, including one typhoon, 18 floods and 22 combined typhoon-floods. These major disasters included the severe flood of 1983, a destructive typhoon in 1985 and an historic flood in 1999. The loss of/damage to property and houses, combined with the impact on living and working conditions, keep many households trapped in a cycle of poverty (Tran and Shaw 2007).

Besides the national-level strategies for disaster management – such as construction of dike systems and upstream reservoirs and a program to eliminate the use of temporary housing for the poor – response efforts and preparedness at the local level and the knowledge that residents gain from experience are crucial for natural disaster prevention, response and mitigation. This paper focuses on Huong Phong commune, located adjacent to the Tam Giang lagoon, as its study area and explores the impact of typhoons and flooding on local people over the past 25 years. It examines the local authorities' response efforts and reveals how households are adapting to prepare for future disasters.

Study area: Tam Giang lagoon

The study area, the Tam Giang lagoon, is one of the largest lagoons in Asia. Located in Thua Thien Hue province, central Vietnam (Figure 1), it covers about 22,000 hectares and stretches 70 km along the eastern coast of Vietnam. The area has about 300,000 inhabitants in a total of

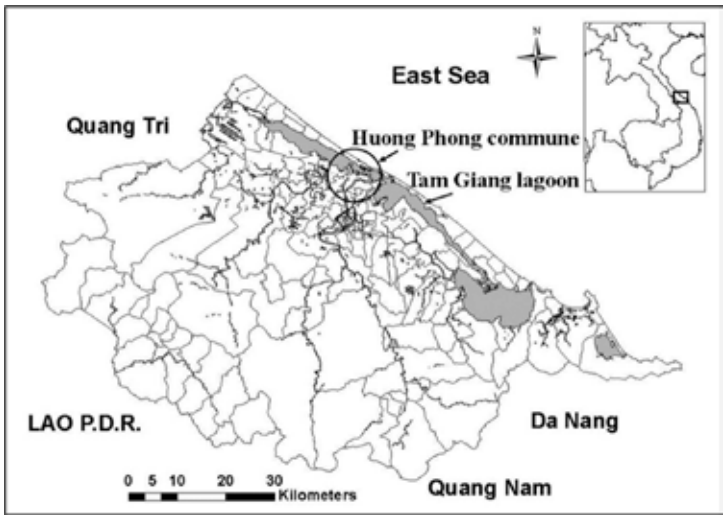

Figure 1. Location of the study area

236 villages from 32 communes (Nguyen and De Vries 2009). Lagoon communities generally depend on three main income sources: agriculture, captive fisheries and aquaculture. Other complementary income sources are non-agricultural activities such as small-scale trade, milling, and tailoring (Integrated Management of Lagoon Activities 2006 and Mai et al. 2006). This area is extremely prone to natural disasters. During the rainy season, crops, infrastructure and houses around the lagoon are often damaged by seasonal flooding and, occasionally, typhoons. In years with lower amounts of rainfall, saline seawater intrudes into rivers and paddy fields during growing seasons and sometimes causes salt damage. Natural disasters directly disturb household economies and constrain the socio-economic stability and growth of Thua Thien Hue province (Tran et al. 2011).

This study was carried out in Huong Phong commune, 1,569 hectares of mainly low-level terrain with alluvial soil used for rice cultivation and aquaculture. In 2006, the population totalled 11,824 people in 2,125 households (Center for Agricultural-Forestry Research and Development 2007). According to Tran et al. (2011), 22.5 per cent of the population of Huong Phong commune lived below the official government poverty line in 2008.

Methodology

Three field surveys were conducted from June to September 2009 and in February 2011 in two villages in Huong Phong commune (Figure 2). Van Quat Dong village is located along the coast of the lagoon and Tien Thanh village in an area inland from the coastline. The first survey was carried out on 477 households (322 households in Van Quat Dong and 155 households in Tien Thanh) to identify households' working practices and the impact of the

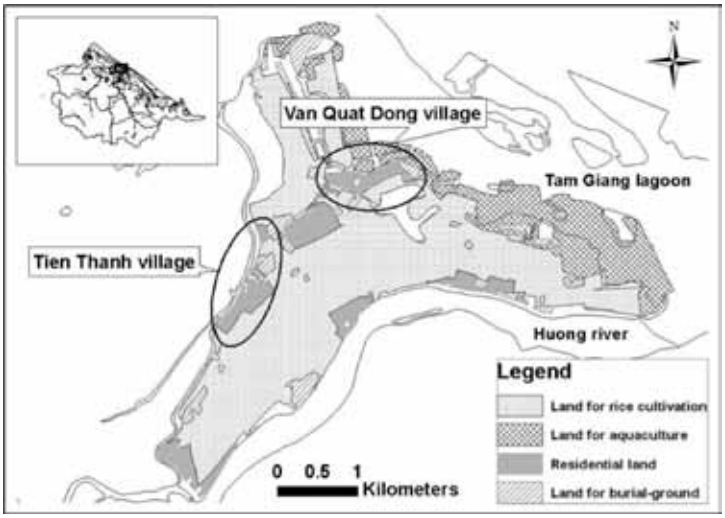

Figure 2. Two villages in Huong Phong commune

1999 flood. For the second survey, 50 households in Van Quat Dong and 30 households in Tien Thanh were selected to explore in greater detail household income sources and local residents' experience of coping with flooding and typhoons. A third survey was carried out among 427 households in Van Quat Dong, which focused on taking field measurements of housing and conducting interviews using a questionnaire. The height of house foundations from the ground level was assessed directly using a measuring tape. The questionnaire was designed to collect housing information, including type and year of construction and household income. The collected data was analyzed statistically using Statistical Package for the Social Sciences (SPSS) software.

A meeting with the leaders of the commune and villages collected information on local authorities' response activities and disaster preparedness.

Results and discussion

Disasters and damage in the past 25 years in Huong Phong commune

Huong Phong commune, surrounded by fields for rice cultivation and aquaculture, is located on flat coastal terrain with a height of only 1-2 m above sea level, which makes the area prone to flooding. Table 1 shows the occurrence of notable disasters caused by typhoons and floods in the past 25 years. As shown in Table 1, villagers designated typhoons and flooding as the major types of natural disasters in Huong Phong. They mainly occur during the rainy season and seriously affect life and livelihood.

In 1999, a major flood hit central Vietnam, killing 780 people, inflicting damage that affected one million residents and sinking or damaging more than 2,100 boats. The cost of the flood totalled US$364 million (Central Committee for Flood and Storm Control 2006). The floods made a severe impact on the food reserves, animal husbandry and aquaculture of

Table 1. Disasters and types of damage caused in the past 25 years in Huong Phong

Date	Type of disaster	Main damage
November 1985	Typhoon and flood	22 deaths 600 houses collapsed and roofs blown off
November 1999	Flood	5 deaths 200 houses collapsed 300 dead cattle and 20,000 dead poultry
November 2004	Whirlwind	1 injured 17 houses collapsed and roofs blown off
September 2006	Typhoon	2 injured 345 houses damaged
September 2009	Typhoon and flood	1 injured 43 houses collapsed and roofs blown off 1,900 dead poultry

Sources: Center for Agricultural-Forestry Research and Development (2007)
and Huong Phong Commune People's Committee (2009)

Huong Phong's residents. About 85 per cent of households lost their rice supplies, with the average amount lost per household coming to approximately two tons. This flood killed 35 buffaloes, 223 pigs and 3,888 poultry. The cost of the damage to aquaculture averaged VND20.03 million per household (with standard deviation of ± 15.21 million). This flood also affected housing conditions, with 20.2 per cent of the houses collapsing, 13.0 per cent suffering collapsed kitchens and 14.5 per cent blown-off roofs or damaged walls.

Disaster preparedness at the local authority level

According to the Joint Advocacy Network Initiative (2010), the "four on the spot" disaster resilience program was based on experience gained in protecting and strengthening the dike system in the Red River Delta and in the North Central area in the early 1970s. This experience showed that careful and deliberate efforts were required to ensure the safety of the dike system and the prevention of flooding in low-level areas. The program requires the leader to be able to organize, coordinate and mobilize all necessary resources from the community and local government and proposes that each community create a flexible, well-prepared response team that does not rely on outside resources. All participants must be on high alert and proactive in taking action at any stage or at any time to protect the dike systems. Since then, this approach has been gradually consolidated and developed into the "four on the spot" program, which includes local leadership, human resources, strategies and materials. The actual implementation of the program has demonstrated its strength and effectiveness in disaster management, enabling residents to respond effectively to natural disasters such as the historic floods in the Red River Delta in 1971, in Nghe An and Ha Tinh provinces in 1978 and in Thanh Hoa province in 1980.

To reduce damage from disasters, particularly seasonal flooding and typhoons, Huong Phong commune organizes and supports committees for flood and typhoon control at the commune and village levels every year to organize and mobilize local residents to respond to disasters. The "four on the spot" approach achieves maximum effectiveness in preparedness,

response and rehabilitation by using local resources to reduce loss of life and damage to public and private property.

The committee at the commune level has 15 members, including the chairman and vice-chairman of the People's Committee. The committee at the village level is managed by nine members, including village heads and leaders of village mass organizations such as the Farmers' Association, Women's Union, Veterans' Union, Senior Citizens' Union, Youth Union and Homeland Front. Both committees focus on the following activities.

1.Before flood/typhoon (preparation)
Preparatory activities – such as harvesting agricultural and aquatic products before the rainy and flood seasons, reinforcing housing structures, anchoring boats and cutting down trees – are implemented to help prevent disasters. The committees for flood and typhoon control at the commune and village levels develop plans for disaster prevention and allocate responsibilities to committee members. Villagers are trained and instructed in prevention activities and informed via emergency broadcasting loudspeakers. Rescue facilities, such as boats and life jackets, and food are prepared. Residents living in dangerous areas are evacuated to safer areas.

2.During flood/typhoon (prevention)
The committee for flood and typhoon control at the commune level is on duty 24 hours a day to ensure a timely response in urgent situations. Rescues are organized if residents are deemed to be in danger. Food supplies are distributed to villagers. Households located in dangerous areas or residents who are out fishing are informed or forced to move to safer places during flooding or typhoons.

3.After flood/typhoon (response)
The amount of damage incurred is assessed and reported to higher levels of government. Residents' physical security and livelihoods are quickly stabilized without waiting for external support. The committees receive and distribute goods to the villagers for rehabilitation. The committees clean up the affected areas and work to prevent diseases. The motto "people who are less affected help those who are more affected" is used at the community level after disasters. Meetings are organized to assess activities and share experiences of coping with flooding and typhoons.

Disaster response and preparedness at the household level

To prepare for natural disasters and minimize their impact, local residents have applied the experience they have gained from previous disasters. For example, they have diversified their work, employed coping strategies for flooding and typhoons, changed housing construction in response to the 1999 flood and used local knowledge to help predict disasters.

The principal farming activities in Huong Phong commune are rice cultivation, aquaculture and animal husbandry. According to the survey, these activities account for 65 per cent of total household income in Tien Thanh village and 51 per cent in Van Quat Dong village. Nevertheless, they are affected directly by weather conditions, particularly seasonal flooding. To mitigate the impact of typhoon and flood disasters, local people diversify their work to lessen risk and provide buffer incomes when the main source of income disappears. Twenty-five discrete livelihood activities were recorded in Huong Phong (Table 2), indicating that many local residents combine rice cultivation with other activities to earn household income. In the case of Mr Tran On's family, for example, family members are engaged in seven livelihood activities: rice cultivation, fishing, masonry, ploughing, electronic repairs, tailoring and hired labor. Of these, rice cultivation, fishing, electronic repairs and tailoring are the main income earners. The other activities are minor in scale and tend to be seasonal. Livelihood diversification brings in additional income, which can be used to pay for items useful for disaster mitigation, such as emergency food and boats. Some jobs are less affected by flooding than others so having a range of livelihood activities enables a family to continue to work in the event of a disaster.

Table 2. Livelihood activities and seasonal occurrence in Huong Phong in 2009 (number=477)

Activities	Seasonal frequency	Households involved (%)
Rice cultivation	January to August	69.0
Animal husbandry	January to August	14.0
Aquaculture	January to August	10.7
Fishing	Year round	15.1
Masonry	January to August	33.5
Iron window production	Year round	3.1
Carpentry	Year round	3.1
Electronic repair	Year round	2.9
Electrical work	Year round	1.3
Conical hat sewing	Year round	0.4
Bamboo weaving	Year round	0.4
Incense stick production	January to August	1.5
Tailoring	Year round	18.2
Hairdressing	Year round	1.9
Shoemaking	Year round	2.9
Plough machine operation	January and May	3.1
Motorbike repair	Year round	2.7
Photography	Year round	0.2
Lottery ticket sales	Year round	2.3
Motorbike taxi driving	Year round	0.6
Cement brick production	Year-round	0.2
Hired labor	Year-round	19.5
Pension	Year-round	3.4
Officer	Year-round	9.2
Small-scale trade	Year-round	42.6

Source: first survey

Households' response to floods and typhoons is shown in Table 3, Figure 3 and Figure 4. Typically, a family determined the height of its house foundations based on the water level experienced during annual flooding. However, after the major flood of 1999, 30 per cent of households built houses with higher foundations. They also reinforced their houses (by constructing mezzanines, using brick and cement blocks to raise properties to minimize flood damage, using sand bags and banana or bamboo trees on the roof to prevent typhoon damage), built up food reserves, purchased small boats and evacuated to safe places during floods and typhoons. As can be seen in Table 3, 62.5 per cent of households reserved food supplies for the 2009 rainy season. In addition, 22.5 per cent of households purchased small boats because boats are the only means of transport during a flood at the study site. During the 1999 flood, 17.5 per cent of households evacuated from their houses to safer places, such as the permanent houses of relatives, neighbors, schools and the commune offices.

Table 3. Local residents' experience of coping with floods and typhoons in Huong Phong in 2009 (n=80)

Experiences	Percentage of households (%)
Constructing a house with high foundations	30.0
Adding a mezzanine	30.0
Using brick and cement blocks to raise properties	20.0
Using sand bags and banana or bamboo trees on the roof	20.0
Building food reserves	62.5
Purchasing small boats	22.5
Evacuating to safer places	17.5

Source: second survey

Courtesy: Dan Tri

Figure 3. New house with high foundations (left) mezzanine (middle), and properties raised using bricks and cement blocks (right)

Figure 4. Food reserves (left), small boats (middle) and safe house (right)

Changes in house construction after the 1999 flood

Current approaches in house construction can serve as an indicator of local adaptation to typhoons and flooding. Based on the housing materials mentioned in the first survey, three types of housing were identified in Van Quat Dong village: permanent, semi-permanent and temporary. The main materials for the first category are concrete, steel and brick with high foundations (100.7 ± 19.4 cm). The second type indicates a house constructed of brick, wood, tiles or corrugated iron sheets with lower foundations (80.0 ± 20.1 cm). The last type features bamboo, cement fibers and grass thatch with the lowest foundations (50.0 ± 11.8 cm). The difference in foundation height among the three housing types is statistically significant (Table 4).

Table 4. The height of foundations from ground level by housing type in Van Quat Dong

Housing type	Number	Min (cm)	Max (cm)	Mean (cm)	SD (cm)
Permanent	98	50	150	100.7[a]	19.4
Semi-permanent	308	30	160	80.0[b]	20.1
Temporary	21	30	70	50.0[c]	11.8

Note: the mean figures show significant differences at the 5 per cent level. SD = standard deviation.
Source: third survey

Table 5 compares houses constructed before and after the 1999 flood. The difference in the foundation height of permanent and semi-permanent houses was found to be statistically significant (p-values=0.000). In contrast, no significant difference was found in the foundation height of temporary houses constructed before and after the 1999 flood. According to the survey results, 71.4 per cent of families living in temporary houses have a monthly income below the national poverty line of VND400,000 per capita, equivalent to US$21 (February 2011). This suggests most poor households are still unable to prepare adequately for flooding.

Another example of local adaptation is an increase in the number of two-storey houses. Although only two two-storey houses were constructed before the 1999 flood in Van Quat Dong, there are now 13 two-storey houses in the village. According to the owners of the 11 two-storey houses constructed after the 1999 flood, their main purpose for building these houses was to cope with flooding as experienced in 1999.

Table 5. Differences in house foundation height from ground level before and after the 1999 flood in Van Quat Dong

Housing type	Time of construction	Number	Mean ± SD (cm)	p-value*
Permanent	Before the 1999 flood	24	88.8 ± 18.5	0.000
	After the 1999 flood	74	104.5 ± 18.2	
Semi-permanent	Before the 1999 flood	190	73.5 ± 17.6	0.000
	After the 1999 flood	118	90.3 ± 19.6	
Temporary	Before the 1999 flood	14	52.1 ± 11.2	0.250
	After the 1999 flood	7	45.7 ± 12.7	

Note: *indicates significant difference at p-value <0.05
Source: third survey

Local knowledge of disaster prediction

Over generations, the residents of this disaster-prone area have developed traditional knowledge that helps them to predict disasters and act accordingly. Because they are highly aware of – and responsive to – natural indicators, residents are more likely to prepare for natural disasters. Local residents' prediction techniques are presented in Table 6, Figure 5 and Figure 6. Table 6 shows how changes in the natural surroundings can be used to predict flooding. When leaves of the *cha* tree fall regularly, there will be a big flood that year; if land orchids blossom, flooding will occur; when *goby* fish eat sand and grit, heavy rains and flooding are expected; bent blades of *ong* grass suggest how many times it will flood; when the root of the *cua* tree turns white, there will be flooding and when ants make their ant-hills in a high spot, there will be a big flood that year. Typhoons are predicted according to the appearance of bamboo shoots (when shoots grow towards bushes, there will be a big typhoon) and clouds (clouds that resemble mountains in the north east portend typhoons). According to interviewed residents, this knowledge, when combined with scientific prediction, is helpful in boosting preparedness. It enables local residents to take the initiative by harvesting rice and aquatic products earlier than usual, selling pigs and poultry before expected flooding, strengthening their houses and preparing essential items such as food, medicine and lamp oil. Irrespective of the predictive accuracy of traditional beliefs, they have a positive effect in fostering a higher awareness of natural disasters and readiness to take action.

Table 6. Natural signs used to predict disasters, according to Huong Phong tradition

Type of disaster	Local knowledge
Flood	When leaves of *cha* tree fall regularly, a major flood will occur that year
	If land orchids blossom, flooding will occur that year
	If *goby* fish eat sand and grit, heavy rain and flooding will occur
	Bent blades of *ong* indicate how many times flooding will occur
	If the root of the *cua* tree turns white, there will be flooding
	If ants make ant-hills in high locations, major flooding will occur that year
Typhoon	If bamboo shoots grow towards bamboo bushes, a big typhoon will occur
	If clouds that resemble mountains in the north east appear in the sky, a typhoon will occur

Source: second survey

Figure 5. *Cha* trees (left), land orchids (middle) and *goby* fish (right)

Figure 6. *0ng* grass (left), *cua* tree (middle) and bamboo shoots (right)

Conclusion

Coping activities and disaster preparedness at the local level are crucial in helping the local population anticipate and respond to natural disasters. This study explored the impact of natural disasters over the past 25 years, notably the effects of the 1999 flood for the surveyed households, and identified response activities and disaster preparedness at local authority and household level in Huong Phong commune, Tam Giang lagoon area, central Vietnam.

Response activities and disaster preparedness at the commune and village levels use local resources and are organized by committees that apply the "four on the spot" credo of local leadership, forces, materials and logistics to cope with flooding and typhoons.

The most common strategies employed at the household level were diversifying livelihood activities, adopting new approaches to house construction, building up food reserves for the rainy season, buying small boats and using traditional local knowledge to predict disasters. The elevation of permanent and semi-permanent house foundations and an increase in the number of two-storey houses provided clear evidence of how local people have adapted their behavior in the aftermath of the severe floods of 1999.

Acknowledgements

This study was supported by a Japan Society for the Promotion of Science Grant-in-Aid for Scientific Research (No. 20401008). The authors wish to acknowledge the kind cooperation of members of Hue University of Agriculture and Forestry.

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